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PSW FOREST AND RANGE
EXPERIMENT STATION
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PACIFIC NORTHWEST
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U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

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FOREST HYDROLOGY LABORATORY
PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION
FOREST SERVICE
U. S. DEPARTMENT OF AGRICULTURE

WENATCHEE, WASHINGTON. The 17,000-square-foot Forest Hydrology Laboratory was designed for research aimed at increasing water yields without floods, preventing erosion, and restoring stability to eroded forest and range watersheds.

BEND, OREGON. The Silviculture Laboratory features wood construction and provides a headquarters for timber-growing research for the 21 million acres of commercial forest land in eastern Oregon and eastern Washington.

INTRODUCTION

In an effort to save our readers' time, and our own, we have prepared this streamlined summary of research results and activities during 1964 and of plans ahead. Although this report contains fewer than half as many pages as our recent annual summaries, it highlights a somewhat larger research accomplishment. Should our readers desire more details or have any suggestions relating to this report or to the research itself, we shall welcome both questions and comments.

One indication of productivity in terms of completed research is the Station's list of publications in the final pages of this report. Some of our accomplishment consisted of strengthening research and reshaping programs so as to maximize the returns, forthcoming in the form of new knowledge, from research investments. During the year, Congress provided for some strengthening of the Station's research in insect, disease, and animal damage control, in watershed management, and in forest mensuration, survey, and engineering.

The new Forest Hydrology Laboratory at Wenatchee, Washington, and the Silviculture Laboratory at Bend, Oregon, were dedicated in March and May, respectively, with appropriate ceremonies.

As our report indicates, most of the Station's research is in cooperation with others--the universities, the States of Oregon and Washington, forest industries and owners, the U.S. Bureau of Land Management, the Bonneville Administration, the U.S. Bureau of Indian Affairs, and administrative units of the U.S. Forest Service. The Station increasingly benefits from the counsel of its advisory committees and the advice and cooperation of many other groups and individuals.

Our research relates to four major objectives: growing, protecting, measuring, and using the multiple forest resources. Growing of timber and forage is basic to the perpetuation and increase of forest values. Protecting the forest from fire, insects, disease, and animals is now complicated by concern for the direct and indirect effects of pesticides on ourselves and our environment. Measuring the resources involves the rate of vegetative growth and yield, inventorying all the resources, and analyzing potentials. The goal is the multiple use of all forest resources for high and sustained yields of wood, water, forage, wildlife, and recreation.

In April 1964, the Forest Service's "A National Forestry Research Program" was presented to the Congress by Secretary of Agriculture Freeman. We are now in the third year of this proposed 10-year coordinated research effort, and, at this stage, about two-fifths of the national program, as well as that relating to the Pacific Northwest, is or will be activated.

The bulletin summarizing the National Forestry Research Program points out that 2.7 percent of the United States gross national product has been spent on all research and development in recent years. Forestry research expenditures, in comparison, are about 0.35 percent of the gross national product contributed by forest products. Thus, comparatively, investments in forestry research are at only about one-eighth of the average level for all research.

GROWING THE NEW TIMBER CROP

Planting over 125,000 acres yearly in the Pacific Northwest requires vigorous seedlings that survive well and grow rapidly. To learn how to "build" more vigor into planting stock, we have studied seasonal changes of food reserves in relation to root and top growth of Douglas-fir at Wind River Nursery. Food reserves peak during winter months. As roots grow in early spring and shoots in early summer, reserves dwindle continuously. Late summer buildup of reserves is subsequently depleted by early fall root growth. Knowing this sequence, the nurseryman can better take advantage of high food reserve levels by lifting planting stock when it is best prepared to grow rapidly in the field. Other leads to further improve seedling vigor are now under study.

In a cooperative study with Oregon State University, Douglas-fir seedlings from a dry, interior seed source were found to be more drought resistant than seedlings from a wet, coastal seed source. None of the seedlings from coastal sources survived when soil moisture content fell below 1.6 percent. In contrast, 25 percent of the seedlings from interior sources survived when soil moisture was below this point. These results emphasize that seed source may be a vitally important factor in survival of Douglas-fir seedlings on dry south slopes in southwestern Oregon where regeneration is especially difficult.

An augmented forest genetics staff at Corvallis made it possible to give greater emphasis during 1964 to studies in seed orchard technology and problems engendered by the rapid development of Northwest seed orchards by both public agencies and private companies.

A valuable finding from recent seed orchard research is that cone production in any given year is correlated with numbers of male buds formed the previous year. Since male buds at low elevations can be fairly well identified as early as May, a first estimate of cone production can be made 16 months prior to seedfall. Previously, the earliest predictions were based on development of female buds which cannot be identified until late August--only 12 months before seedfall. Indications are that these May predictions can be further sharpened through a followup examination in early July to determine proportion of male buds that have aborted. An ability to predict next year's crop as early as July is highly important to seed collectors. They can adjust collection plans for the current year to meet the possible impact of a bumper crop or a crop failure the following year.

Early autumn aerial spraying successfully released young Douglas-fir and ponderosa pine saplings from brush competition on some 5,000 acres of National Forest and Bureau of Land Management lands in western Oregon. These operations were based directly on research findings from the Station's Brushfield Reclamation Project at Roseburg, Oregon. Formerly, only early spring applications of herbicides were used to release Douglas-fir from brush competition. These new research results make it possible to release Douglas-fir in either spring or fall and, for the first time, define a season when ponderosa pine, which is

much more susceptible to herbicides, can be treated successfully. In addition, because flying weather is better in early fall than in spring, time spent by flying crews waiting for suitable weather is greatly reduced. Compared with manual weeding or spraying in ponderosa pine plantations, fall aerial spraying will result in savings of $35 to $40 per acre. Fall spraying is effective on Pacific madrone, California black oak, and on many species of ceanothus. Early spring sprays are still best, however, for manzanitas and vine maple.

Research in 1962 demonstrated that high soil temperatures during slash burning induced germination of varnishleaf ceanothus seed that had lain dormant in the soil for many decades. More recent studies show that heat from slash burning also has the same effect on seed of snowbrush, deerbrush, and mountain whitethorn ceanothus. Soil temperatures (in fine-grained sand) from 75° to 105° C. induced germination of snowbrush and mountain whitethorn ceanothus seeds. Slightly lower temperatures, from 60° to 90° C., induced germination of deerbrush seeds. Higher temperatures killed the seed of all three species. These findings indicate that establishment of ceanothus after logging can, to a very considerable degree, be controlled by the method of slash disposal used.

Our research on the economics of timber production and related subjects during 1964 encompassed a wide range. For example, at the completion of one study, tables were published showing the rate of volume growth of individual Douglas-fir trees of various diameters and age, growing on alternative sites, and producing various numbers of rings of diameter growth per inch in recent years. These tables are useful aids in marking trees to be left or cut in a thinning or stand improvement program. When converted to value growth percent, these tables show the financial rate of return being earned by each tree viewed as a capital asset, from age 30 and site index 110 through age 120 and site index 200.

A case study of 13 years of commercial thinning beginning in 45– to 55-year-old Douglas-fir in central western Washington shows the silvicultural practicality and economic superiority of thinning over no thinning. Economic analysis indicated management with thinnings increased total net income after taxes by 3.6 percent. A program of continued light thinning promised a 5-percent earning rate on investment, assuming a gradual stumpage price increase with age and size. This case study effectively demonstrates a method of evaluating alternative Douglas-fir management programs.

Decisions about forestry investments must also reckon with uncertainty about future costs, prices, and other factors affecting the outcome of such decisions. During the year, the results of a study of this issue were published with the conclusion that uncertainty can be ignored generally in comparison with forestry investments whose returns are about equally distant in time.

PROTECTING TIMBER AND USERS

We prepared an interim fire-occurrence factor for use in the Northwest in the new National Fire Danger Rating System. When season-severity ratings for the past 16 years were recomputed with the national spread index, relative ranking of seasons was almost identical to that computed from the old R-6 burning index. The 1963 fire season was rated one of the easiest of record in western Washington and northwest Oregon and was slightly below normal severity elsewhere in the Northwest. The 1964 fire season was the coolest of record in many parts of the region, the dampest in western Washington, and the driest in parts of eastern Washington. In Oregon, the 1964 fire season was slightly less severe than normal in the north half and close to normal in the south half.

In the Cascade Mountains near Oakridge, Oregon, 13 pairs of burned and unburned logging slash plots have been studied during the 16 years after logging. Burning reduced estimated rate of spread of fire for this entire period. Average estimated resistance to control of fire remained higher on the unburned plots for at least 5 years, but the difference was no longer significant at the end of the study. In the first few years, the unburned plots produced more conifer seedlings and more brush cover than the burned, but no significant difference remained after the fifth year. Burning changed the predominant species of both brush and herbaceous cover on the plots. Half the brush on burned plots was ceanothus, and half on unburned plots was rhododendron or vine maple.

A study of tops and branches blown off standing trees by the October 1962 windstorm showed large quantities of this fuel hazard in 50- to 100-year-old stands but not in younger stands or in old growth. An easily applied milacre-plot system of measuring the proportion of ground covered by blowoff was developed, tested, and described.

Half-hourly daytime moisture measurements showed that on dry days following rain or heavy dew, samples of wood, twigs, and bark less than ¼-inch thick lost more moisture than larger pieces. They sometimes dropped from 20- to 35-percent moisture at 8 a.m. to 10 percent or less at 4:30 p.m. Their moisture content likewise increased rapidly with a small amount of rain. The ½- and 1-inch indicator sticks gave a narrower range of moisture variation, and the 2-inch sticks gave a still narrower range, such as 17 percent at 8 a.m. and 13 percent at 4:30 p.m.

Moisture content at the surface and at ¼- and ½-inch depths on tops and bottoms of model logs supported a short distance above the ground were related to those in the small indicator sticks. Changes at the ½-inch depth were related to changes in moisture content of the 2-inch sticks. This suggests that a combination of small and large fuel moisture sticks and records of rain occurrence can provide a reliable index of moisture content of both fine slash and the surface and subsurface of coarse slash and show when the fuel has reached a moisture condition wanted for a slash disposal fire.

A 7-year program of introducing and colonizing insect predators of the balsam woolly aphid has resulted in establishment of 5 of

the 22 species imported. So far, these beneficial insects have not reduced tree killing by the aphid in true fir forests of the Pacific Northwest. Efforts to find and utilize insect predators will be continued as opportunities develop, but our main research on the aphid is being concentrated upon its host tree relationships to develop means for preventing damage through forest management practices.

The electron microscope installed last year at the Forestry Sciences Laboratory in Corvallis has been tested and adjusted and put into operation. This microscope, permitting magnifications in excess of 200,000 times, is being used principally to study diseases of insects. Currently, it is being used to explore the mode of action of viruses, knowledge of which is prerequisite to using viruses effectively for controlling destructive forest insects.

The virus believed to be the most important factor in natural control of the Douglas-fir tussock moth has been concentrated at the Corvallis laboratory from larvae collected by Pest Control personnel in Montana. The concentrated material will be used for field studies in 1965. The objectives are to develop means of culturing, storing, formulating, and applying this virus to speed the process of natural control and to develop means for predicting the occurrence and trend of virus-caused epizootics.

The role of insect blood in diseases caused by insect pathogens is being investigated at the Corvallis laboratory. Underway are studies of the responses of the principal blood cells to *Bacillus thuringiensis* and other pathogens injected into late-stage larvae of the armyworm. The studies of insect blood will be transferred to forest defoliators when techniques are developed for continuous rearing of these insects under laboratory conditions.

Physiological requirements of forest insects, both harmful and beneficial, are an important part of the program at the Corvallis laboratory. A major objective is to rear insects as needed for experimental purposes. Considerable success has been achieved with the Douglas-fir beetle and two species of parasites of forest defoliators.

Findings from some 15 years of research on aerial photographic techniques for increasing the effectiveness and efficiency of forest insect surveys were developed into a manual for practical use. The manual, being issued jointly with the Division of Forest Insect and Disease Control of the Regional Office of the Forest Service, will be published in 1965.

Recommendations by the Northwest Forest Pest Action Council that the European pine shoot moth be eradicated handed the Station the big job of developing practical eradication measures. A start has been made toward determining the feasibility of induced insect sterility, and studies on the behavior and manipulation of the shoot moth are underway. Station researchers will be supplemented by university entomologists under research contracts. Techniques developed for eradication of the shoot moth may be applicable, with suitable modification, to related forest insect control problems.

Addition of pine litter and sawdust to Bend nursery soil increased the populations of *Trichoderma* and *Streptomyces* (soil molds antagonistic to many root pathogens) by as much as 33 percent. This explains in part the helpfulness of organic soil amendments in controlling late root rot. In cooperation with Oregon State University, soil in a mixed stand of alder and Douglas-fir was found to be from 20 to 250 percent higher in

Streptomyces, 190 to 760 percent higher in nitrate nitrogen, and 1.3 pH degrees more acid than soil in a pure Douglas-fir stand. All these factors are known to affect the activity of root pathogens. Such findings are steps toward ultimate control of forest root diseases by natural means.

Progress raises new problems, too. Mycorrhizae, believed important for protection of unsuberized roots against pathogens, can be attacked by aphids (probably *Pemphigus* spp.). To control diseases effectively by natural means, it is obviously going to be necessary to work out the details of many complicated interrelationships among all the organisms that compose a forest community.

Strengthening of pesticide-related research during the coming year will accelerate study of the factors affecting survival of *Poria weirii*, diseases of fine (unsuberized) roots, and population levels of rhizosphere and other soil micro-organisms that may hinder spread of root pathogens from one tree to another.

Pesticides are vitally important tools in forest and rangeland management. Their indiscriminate use, however, may involve hazards to human health and wildlife through contamination of soil and water by chemical residues. To meet the urgent need for facts about this matter, a new project was activated in fall 1964.

Matters of basic concern in the new project are determining how pesticide residues affect soil properties, how soil properties act to retard movement or lead to breakdown of primary chemicals into less toxic or nontoxic forms, and how residues are transported by water flowing over and through the soil. We believe that by developing basic knowledge about these factors and applying it skillfully, we will be able to safely use some valuable chemicals to control insect depredations, unwanted vegetation, or other organisms that pose problems in maintaining high productivity of forest and rangelands.

Practically our entire insect research program is aimed at developing control measures by biological and silvicultural means to minimize need for chemical insecticides. This and other pesticide-related research at the Station is now being materially strengthened.

Systemic chemicals have been used as fertilizers, insecticides, fungicides, antibiotics, herbicides, and growth regulators. Their efficient use in animal damage control, however, remains to be developed. Tetramine, the only systemic compound uncovered thus far through the screening program of the Denver Wildlife Research Laboratory, is now under investigation at Olympia. In cooperation with the Bureau of Sport Fisheries and Wildlife, we are currently engaged in studies with radioactive tetramine to determine its persistence and fate in plants and animals and to evaluate the hazards associated with the use of this highly toxic chemical. The possibility of isolating naturally occurring systemics that could be used in animal damage control is also being explored. Such compounds would have many advantages over synthetic chemicals.

Extent and economic impact of animal damage in newly planted stands of Douglas-fir and ponderosa pine in the Northwest is being surveyed through joint action of Federal, State, and private forestry groups. The Station is participating in this effort, which will continuously appraise, over 5-year periods, the losses in plantations established during 1964 and 1965. Early fall examinations showed that 72 percent of over 100 randomly sampled 1964 plantations suffered animal damage with 1 percent or more of the planted seedlings injured. A supporting study is underway at Olympia to determine the impact of various degrees of damage on survival and growth of Douglas-fir seedlings.

FOREST MENSURATION AND SURVEY

Forest mensuration was reactivated in November with a new project headquartered in Portland. Many misunderstandings concerning usable wood volume in trees, potential yields of forest stands, and allowable cut calculations for Northwest working circles are the result of ambiguous units of measure and inadequate methods for predicting growth and yield. Through the new project, emphasis will be given to overcoming these weaknesses. A second scientist will be assigned to the project in 1965.

During the past year, we completed the Pacific Northwest tabulations and analyses for the national review of timber resources, "Timber Trends in the United States." Two subregional timber resource reports, covering 15 counties in western Oregon, were issued containing new inventory statistics. Statistics on 1963 log production show that the harvest was up 2 percent over 1962 for Oregon and up over 7 percent for Washington.

An analysis of the potential income and employment from the timber resource of the former Flathead Indian Reservation in Montana, prepared for the U.S. Bureau of Indian Affairs, showed that the tribal income from stumpage might triple when the full new allowable cut is reached. Within a few years, 220 to 280 new jobs could also be offered to the Indians in harvesting and processing wood products.

Compilation of the 1963 reinventory of six counties in southwest Washington is finished, and the results will be reported early in 1965. Field reinventory of timber resources of 10 counties in central Oregon was completed, and the results are scheduled for mid-1965 release.

Field work for the reinventory of five counties in western Washington will be completed by October 1965.

A report summarizing the volume of hardwoods in the Douglas-fir subregion has been prepared for release early in 1965.

Our one-man, survey techniques research project was strengthened near year's end by the addition of another scientist with experience in mensuration and automatic data processing.

Major effort in 1964 was devoted to increasing the efficiency of Forest Survey field procedures. Improved methods of measuring stocking in relation to desired levels and of handling discrepancies that crop up during the remeasurement of permanent plots are being developed. Results of two studies were published: one on using aerial photos to assess mortality caused by the Douglas-fir beetle and the other on estimating stand age from photos. Two new studies were begun in cooperation with Oreton State University. These propose to (1) evaluate the possible bias caused by irregular distribution of aerial photo plots and (2) produce an aerial photo volume table for ponderosa pine and associated species.

MULTIPLE USE

WOOD HARVEST AND USE RESEARCH--In 1964, the Forest Engineering Laboratory in Seattle completed a study which indicated possible cost savings, perhaps as much as 20 percent, in road surfacing through use of the new wide single tires on logging trucks. Both wide single and conventional dual tires were laboratory tested by the University of Washington, Department of Civil Engineering, and then service tested on actual logging roads by Weyerhaeuser's Longview Branch.

Harvesting timber from difficult access areas remains a critical problem and occupies the major attention of the Forest Engineering Laboratory. The promise of balloon logging and the need for an engineering evaluation of its potential led the Station to contract with Goodyear Aerospace Corporation for two studies in 1964.

The first, an analytical study, established the mechanical feasibility of balloon logging. It was especially favorable for downhill yarding, and yarding distances appear limited, in the main, only by economic considerations.

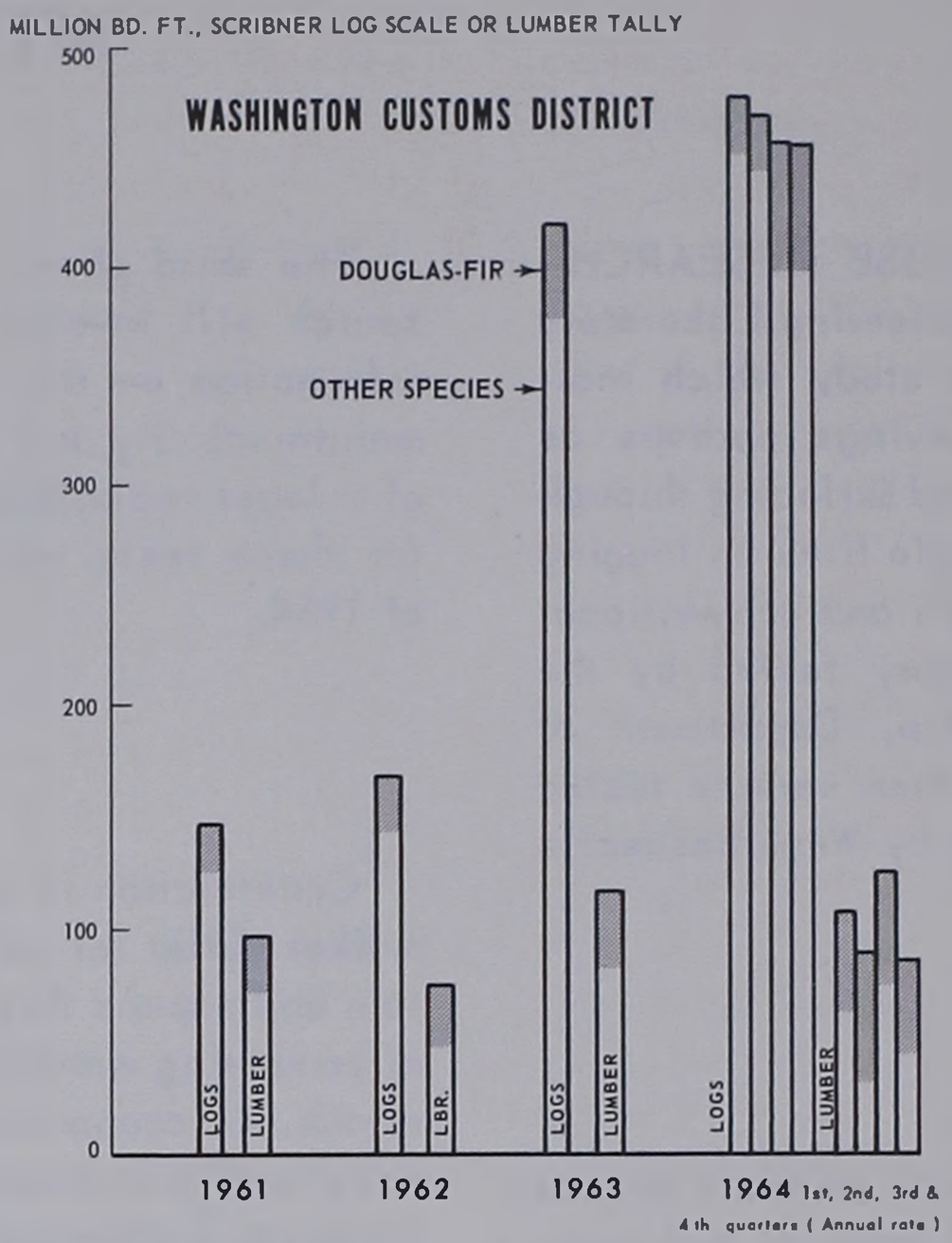
The second study was undertaken to consider an operational concept and to analyze the requirements for balloon support-equipment and crew. This study estimated cycle times as affected by yarder horsepower, yarding distance, ground slope, and load weight. The results indicated that either static or dynamic lift balloons could be used for logging, but that flying logs by balloon and employing maximum dynamic lift should show the most favorable cost.

The third phase of balloon logging research will involve field tests to provide information on the comparative reliability, maintainability, and survival characteristics of at least two balloon configurations. Plans for these tests were underway at the end of 1964.

Construction is by far the largest single-market outlet for western timber. To maintain and expand this market against inroads of competing materials, the Station plans to attack, in cooperation with the timber and construction industries and with the Forest Products Laboratory and the universities, critical wood-construction problems and to seek new opportunities for western wood products in construction.

Research will be problem oriented. The proposal is to determine precisely what is required in each class of construction component and then examine new or existing wood-based product systems that meet these needs most efficiently. The marketing strength as well as the technical merits of proposed systems will be explored to provide a basis for integrating construction knowledge already available and for developing new information and guides for wood construction.

Research to improve timber-quality evaluation was intensified with major attention given to coast-type Douglas-fir. Last year, studies were conducted in Washington, Oregon, and California.



Pacific Northwest softwood log exports, 1961 - 1964.

The first four studies have provided detailed lumber and veneer recovery information for 1,600 saw logs and about 850 veneer blocks. Not only was the grade yield and value of each block or log determined, but the external characteristics of each log and its parent tree were recorded. Findings last year represent about one-third of the total information to be gathered on coast-type Douglas-fir because of its vital importance to the Pacific Coast forest-based economy.

This research allocated whole trees to either veneer or lumber production to insure that recovery values for either product will be available for all classes of logs. The project's recent improvements in analytical methods make it easier to compare the recovery values (as veneer or lumber) from like trees or from adjacent logs in a single tree.

Completion of this product-yield project should lead to improved timber cruising, refined log grading systems, and more profitable log use.

Forest product marketing problems originate with costs of log harvesting and run the gamut of production, promotion, distribution, and eventual use by the consumer.

Final technical work was completed on three manuscripts dealing with logging cost analysis in high-lead and skyline systems. The latter studies indicate that careful planning and engineering are absolutely essential if skyline operations are to be competitive with high-lead systems.

Following the October 1962 windstorm, a comparative study was made of high-lead yarding in windthrown and standing timber. Tree-length yarding in the blowdown area was found to increase logging output per man-hour 27 percent when compared with conventional bucking and yarding in green standing timber.

The board-foot logging residue in older stands in eastern Oregon was found to be only about 1 percent of volume removed and was unmerchantable by National Forest minimum utilization standards, due either to small size or the presence of one or more types of serious defect. In smaller, more vigorous, high-elevation types of mixed species, the logging residue consisted chiefly of small but sound pieces suitable for potential utilization as pulpwood or as small stud logs. Low volumes per acre, however, preclude economic relogging of such material at present. Improved markets for pulpwood or more efficient logging techniques could lead to the economical harvest of about 4 percent more cubic-foot volume than is now removed.

The quarterly reports begun last year on stumpage and log supply have been broadened to give greater emphasis to imports and exports of logs, lumber, and other forest products, and to regional production and employment in the forest industries. Title of the new series is "Production, Prices, Employment, and Trade in Pacific Northwest Forest Industries."

In 1962, softwood log exports from Washington and Oregon Customs Districts were 311 million board feet, Scribner scale. In 1963, these increased to 709 million board feet and were expected to reach approximately 800 million in 1964. During 1964, although log exports increased, both employment and production also increased in the region's lumber and plywood industries.

A study was concluded of mergers and economic concentration in the Douglas-fir lumber industry. Among the motives behind the last 20-year merger activity have been the desire for vertical integration in production and marketing and the resulting opportunities for economies of scale. The degree of concentration, however, was found to be relatively low compared with other industries.

A comprehensive model of the softwood plywood industry was constructed in a cooperative study with Oregon State University. Computer simulation gave opportunity to test effect of several important variables. Two management devices, production control and mill inventory, were shown to be effective in increasing profits in the industry. Simulation thus provides management with a tool to assist in making business decisions and increasing understanding of market behavior.

WATERSHED RESEARCH. -- Research on H. J. Andrews Experimental Forest watersheds shows that since timber cutting began, larger increases in minimum, late-summer streamflow have occurred as more and more of the drainage area has been cleared. A 12- to 22-percent increase in streamflow was associated with vegetation removal on 8 percent of one drainage. Streamflow has increased 85 percent on a watershed where about 80 percent of the timber has been cut. Although percentage increases are substantial, absolute increases in volume of water are small. Due to extremely low flows late in the summer, increases range only from 25 to 100 gallons per acre per day.

A dense forest (90-percent cover) was converted to an open, exposed hillside by logging and controlled slash burning and was immediately planted to 3-year-old Douglas-fir seedlings, which will rapidly develop into the forest stands of the future.

This drastic change in cover was associated with a marked change in wetness of the soil during the summer. Before the logging and burning, water use by plants combined with evaporation from the soil surface reduced soil moisture about 5.8 inches during the growing season. After almost complete removal of vegetation, the reduction was only about 1.3 inches.

These are initial results. We know vegetation returns rapidly to cover the soil. For example, in the first year after logging and slash burning, plants covered 15 percent of the area. It will take additional study to learn just how rapidly vegetation develops and how soon vegetation-soil-water relations will return to normal. Through other associated studies, we hope to learn more about movement of water through soils, into ground water, and eventually into streams.

During the year, steps were taken to establish the Entiat experimental watersheds. A part of the Entiat Ranger District, Wenatchee National Forest, about 4,920 acres are included in the three small drainages. Streamflow calibration, now underway, will be completed in 1967. Then various land use treatments will be applied to determine their hydrologic impact on the watershed.

Tracing soil erosion with radioactive iron ^{59} is one of the signs of an atomic age. Rates and patterns of actual soil particle movement were established by measuring

changes in radiation intensity on an eroding sandstone soil. A 5-foot line of iron[59] was applied to a denuded soil surface in November 1963. Some soil particles moved 2 feet downslope within 2 weeks after the application. Maximum detectable downslope movement of 8 feet occurred over the next 6 weeks during periods of snow and rain.

Overall, more than 70 percent of the iron[59] applied was transported at least 3 inches from the line of application. The erosion pattern developed suggests that once soil particles are detached and eroding, they continue to move downslope.

Plans are underway for further tests on basalt and granodiorite soil parent materials. If iron[59] reacts equally well on these parent materials, we will have a very effective tool for assessing soil erosion on a variety of forest and rangelands.

Basic research involving a method of measuring transpiration, in which a branch is enclosed in a transparent plastic chamber, was tested in the field with Douglas-fir. Although the branch chamber method alters environment conditions, it does permit continuous or repeated measurements of the transpiration rate of the same branch so that trends over short periods of time can be followed. Main disadvantages are that a considerable amount of equipment is required and setting up the equipment is time consuming.

A high-elevation microclimate study took a major step this past summer with installation of the initial 120-foot instrumentation tower. Completion of other equipment for this study is in progress, primarily for wind instrumentation. Sonic anemometry will be used for the vertical wind component with more conventional equipment for the horizontal component.

On mountain rangeland in eastern Oregon, we have found that extreme fluctuations in the quantity of water present in soils and in the amount of summer precipitation are related to soil types and growth of plants that furnish a large proportion of forage for livestock in summer and for wildlife in winter. We now expect to produce usable prescriptions for species selection, planting techniques, and grazing management procedures to minimize the effects of deficient soil moisture, particularly on Albee and Rock Creek soils in the Blue Mountains.

FORAGE RESEARCH. -- For several years we have been preparing a range plant list, with electronic data processing symbols, current with the latest developments in taxonomy of Northwest plants. Now, with cooperation of the Oregon State University Range Management Department, we are not only making the electronic gadget print out the first copy of the list, which is over 50 feet long, but we are instructing it in how to make revisions in the list. This will save many months of delay in making available up-to-date plant symbol lists to public agencies and individuals who make range surveys and do range research.

Fence-line comparisons of heavy vs. light and moderate vs. light summer cow use on uniform antelope bitterbrush stands revealed a highly significant reduction in shrub density under heavy grazing but none

under moderate grazing. When the reduction in shrub density associated with heavy grazing was considered in terms of accompanying changes in age structure, two interesting generalizations appeared: (1) the reduction resulted primarily through lack of replacement and (2) extremely heavy use did not alter the longevity of established shrubs. The age structure analyses in this study provide information for the development of guidelines for technicians and administrators who need to detect early range trends as well as the general condition of bitterbrush ranges.

WILDLIFE RESEARCH.--First-year observations of deer feeding during the fall-winter-spring period on range not used by cattle showed a sudden partial shift from bitterbrush to green Sandberg's bluegrass in April and another sudden shift to new inch-long leaders of low sagebrush in mid-May. Hereford cattle, grazing in an area with year-round protection from deer, preferred low sage flats and seasonal drainages during the first part of the spring period. Then they gradually moved to the surrounding bitterbrush-bunchgrass habitat. Only light use occurred in timber-browse types. Bitterbrush use by cows on the bitterbrush-bunchgrass type reached 55 percent by mid-June and 63 percent by late June.

In an area open to deer and cattle, cow-use patterns were similar except for bitterbrush which had been completely used by deer during the winter. Instead of bitterbrush, the cows in this area used 30 percent more herbaceous forage than they used in the area where bitterbrush was available.

This information on patterns of use by deer and cattle will provide guidelines for proper seasons and intensities of grazing by these two kinds of animals. Ultimately, this work should provide a basis for efficient range management to obtain compatible use by big game and livestock on the same winter ranges.

RECREATION RESEARCH. -- In this project, we developed a method of using unmanned registration stations on wilderness trails to gather basic information about use of wilderness areas. We also applied systematic, participant-observation techniques to recreation problems. Both methods proved to be efficient tools for assessing wilderness use to aid in making administrative decisions.

With this methodological base, we have moved ahead to a definitive appraisal of the use on two Pacific Northwest wilderness areas. We also completed research comparing the social characteristics of roadside and wilderness campers. Indications are that wilderness recreation is largely a family activity and that administration of wilderness areas should include planning for recreational use by family units.

Some of the contributions made by study of wilderness as a land allocation problem include: an updating of the compilation of wilderness literature; classification of points of view about the multiple use concept; classification and critique of economics valuation methodologies and choice mechanisms in outdoor recreation; quantification of some economic consequences of wilderness classification in the Pacific Northwest; and the development of a point of view regarding the need to use both economic and noneconomic facts together to make land use decisions.

PUBLICATIONS AND ADDRESSES

DISEASE

PUBLICATIONS

CHILDS, T.W.

Ponderosa pine needle cast. In Internationally Dangerous Forest Tree Diseases. U.S. Dept. Agr. Misc. Pub.. 939. p. 97. (Reprints not available.)

(A brief summary of information previously published.)

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Diseases of Pseudotsuga. In Diseases of Widely Planted Forest Trees. Mimeographed report of FAO-IUFRO Symposium on Internationally Dangerous Forest Diseases and Insects. pp. 121-130. (Reprints not available.)

(Discusses factors to be considered in protection of native stands from introduced diseases and of exotic stands from both local and introduced diseases.)

NEAL, J.L., JR.,* BOLLEN, W.B.,* and ZAK, B.

Rhizosphere microflora associated with mycorrhizae of Douglas fir. Canad. Jour. Microbiol. 10: 259-265, illus. (Reprints not available.)

(Differences in populations of bacteria, molds, and *Streptomyces* were found between three morphologically different mycorrhizae of a Douglas-fir, and also between the mycorrhizae, adjacent suberized roots, and nonrhizosphere soil.)

NELSON, EARL E.

Some probable relationships of soil fungi and zone lines to survival of Poria weirii in buried wood blocks. Phytopathology 54: 120-121, illus.

(Positively correlates survival of *P. weirii* with formation of zone lines in the blocks. Invasion of the blocks by *Trichoderma* species antagonistic to *P. weirii* was negatively correlated with presence of zone lines.)

TRAPPE, JAMES M.

Mycorrhizal hosts and distribution of *Cenococcum graniforme.* Lloydia 27: 100-106, illus.

(New reports of hosts and occurrence indicate the wide adaptability and distribution of this mycorrhizal fungus. It is common throughout forested areas of much of the Northern Hemisphere.)

ZAK, BRATISLAV.

Role of mycorrhizae in root disease. Ann. Rev. Phytopath. 2: 377-392. (Reprints not available.)

(A literature review and discussion of the hypothesis that mycorrhizae, in addition to improving nutrient absorption, benefit the tree by protecting unsuberized roots from attack by pathogens.)

FIRE WEATHER

PUBLICATIONS

CRAMER, OWEN P.

The 1963 fire season in the Pacific Northwest. Pac. NW. Forest & Range Expt. Sta., 9 pp., illus.

(Western Washington and northwestern Oregon had their least severe fire season

*Federal, State, or private cooperator.

in 20 years with slightly below normal severity elsewhere in the two States. The season will be remembered for a cold, cloudy July, exceedingly warm September, and the most thunderstorm days in 14 years' record on 8 of the Region's 19 National Forests.)

STEEN, HAROLD K.

A measure of wind-caused fuels. U.S. Forest Serv. Res. Note PNW-17, 4 pp.,illus.

(Quantity of wind-caused fuel--broken-off tops and branches, but excluding downed trees--may easily be measured. These fuels were rarely found in old growth or very young stands, but were common in 50- to 100-year-age stands.)

UNPUBLISHED TALKS AND PAPERS

BRUCE, DAVID.

Current status of fire research in the Northwest. Northwest Forest Fire Council annual meeting, Portland, Oreg. November.

(A summary of current fire research at the Pacific Northwest Forest and Range Experiment Station.)

CRAMER, OWEN P.

Cloud motions for fire behavior trainees. Bureau of Land Management Regional Fire Behavior School, Portland, Oreg. January.

(This slide lecture teaches interpretation of clouds in terms of atmospheric motions, developing and approaching weather, and airmass properties. The 70 slides include diagrams of typical cloud motions and extra cloud scenes for student discussion.)

A mesometeorological research project in the Cascade Range. Oregon Academy of Science meeting, Monmouth, Oreg. March.

(The Cascades Fire-Weather Project is aimed at investigating the relatively unknown small-scale weather events and patterns that occur in mountainous terrain but are too small to show up in usual weather analyses. These phenomena may affect formation of fire whirlwinds, the ventilation and intensity of the fire, and wind patterns in the fire vicinity.)

Report on the Cascades fire-weather project. Conference of Western Fire Weather Meteorologists, Portland, Oreg. March.

(Many Federal, State, and private agencies cooperated in the initial summer's observation of little known mesoscale weather events and structures likely to affect wildfire behavior in mountainous terrain. On 19 days, double theodolite balloon runs, rawinsondes, and a Cessna-mounted aerograph supplied upper-air information above the 35-mile square in which 27 stations made surface observations.)

LYNOTT, ROBERT E.

Detailed surface analysis of the October 12, 1962 (Columbus Day) storm in Oregon and Washington. Conference of Western Fire Weather Meteorologists, Portland, Oreg. March.

(This intensive reanalysis of the structure of the storm has satisfied several puzzling questions. The significant features are listed.)

INSECTS

PUBLICATIONS

CAROLIN, V.M., and COULTER, W.K.

Testing partial atmospheric fumigation for eradicating European pine shoot moth on baled and bagged pine seedlings. U.S. Forest Serv. Res. Note PNW-18, 8 pp.

(Judged by larval mortality, both baled and bagged seedlings were effectively treated by partial atmospheric fumigation during the dormant period with minor damage resulting.)

JOHNSON, N.E.,* BUFFAM, P.E.,* and McCOMB, D.*

Sampling egg populations of western hemlock looper in coastal forests. U.S. Forest Serv. Res. Paper PNW-14, 13 pp., illus.

(Distribution of eggs on overstory trees and ground sites was studied in order to improve survey techniques in detecting and evaluating infestations.)

WEAR, J.F., POPE, R.B., and LAUTERBACH, P.G.*

Estimating beetle-killed Douglas-fir by aerial photo and field plots. Jour. Forestry 62: 309-315.

(A procedure is outlined for conducting aerial photographic surveys of Douglas-fir beetle epidemics. Color was found more efficient than panchromatic photography.)

WILLIAMS, CARROLL BURNS, JR.

The impact of defoliation by the spruce budworm on the growth, specific gravity and competitive abilities of three tree species in northeastern Oregon. Diss. Abs. 24(6): 2208-2209. 1963. (Reprints not available.)

(Reductions in radial, height, and volume growth and specific gravity on all trees were related to damage intensity. The fast-growing grand fir was affected the most, Engelmann spruce intermediately, and Douglas-fir least by defoliation.)

*Federal, State, or private cooperator.

UNPUBLISHED TALKS AND PAPERS

WILLIAMS, CARROLL B., JR.

Damage symptoms as related to growth. Western Forest Insect Work Conference, Banff, Alberta. March.

(Damage symptoms exhibited by trees attacked by the spruce budworm in eastern Oregon were closely related to reductions in tree growth. Radial increment illustrated the annual and cumulative effects of budworm feeding more clearly than height and volume increment. This was determined through graphical examinations, covariance, and multiple range tests.)

LOG PRODUCTION

PUBLICATIONS

ADAMS, THOMAS C.

Some characteristics of a sample of logging residue in eastern Oregon. U.S. Forest Serv. Res. Note PNW-10,5 pp.,illus.

(Inventories and classifies logging residue. Nearly all board-foot residue was in pieces below National Forest utilization standards, and many pieces contained more than one defect.)

BERGER, JOHN M.

1963 Washington log production. Pac. NW. Forest & Range Expt. Sta., 2 pp.,illus.

(Chronicles log production by ownership for 1950-63 and gives detail by counties for 1963.)

BINKLEY, VIRGIL W.

A comparison of high-lead yarding production rates in windthrown and standing timber. U.S. Forest Serv. Res. Note PNW-13, 9 pp., illus.

(Tree-length yarding should increase yarding production by reducing number of pieces handled and increasing average turn volumes; does increase felling and bucking production per man-hour.)

Research objectives and developments on the concept of vertical logging with helicopters. Auburn Forestry Forum Proc. 1963: 11-22. (Reprints not available.)

(Described helicopter logging systems and discussed need for research in operational techniques, automatic hooking and release mechanisms, and study of tree and log weights.)

ESTEP, ELDON M., and HUNT, DOUGLAS L.

Lumber yield and log values of white fir. U.S. Forest Serv. Res. Paper PNW-20, 35 pp., illus.

(*Abies concolor* lumber yields recovered in southern Oregon were summarized to provide log values realized under grading and scaling systems used east and west of the Cascade Range.)

FLORA, DONALD F.

Uncertainty in forest investment decisions. Jour. Forestry 62: 376-380, illus.

(It is proposed that if certain assumptions are plausible and if decisions are between forestry investments whose returns are about equally distant in time, then uncertainty can be ignored. As a yardstick of profitability, some analyses of forestry rates of return, unadjusted for uncertainty, are cited.)

GOODYEAR AEROSPACE CORPORATION.*

Balloon logging systems; phase I - analytical study. Pac. NW. Forest & Range Expt. Sta., 111 pp., illus.

(An analysis prepared under contract with Goodyear Aerospace Corp. Provides basic information on balloon logging as a potential solution to problem of logging steep slopes.)

Balloon logging systems; phase II - logistics study. Pac. NW. Forest & Range Expt. Sta., 171 pp., illus.

(A second analysis prepared under contract with Goodyear Aerospace Corp. Develops an operational concept and determines the requirements for balloon support equipment and personnel.)

LANE, PAUL H.

Grades for inland Douglas-fir saw logs in standing trees. U.S. Forest Serv. Res. Note PNW-19, 5 pp.

(These grades are primarily for application to 16-foot logs as cruised in standing timber. The grading specifications are based on branches (or branch stubs), scars, sweep, and log diameter.)

METCALF, M.E.

1963 Oregon log production. Pac. NW. Forest & Range Expt. Sta., 2 pp., illus.

(Chronicles log production by ownership

*Federal, State, or private cooperator.

for 1951-63 and gives detail by counties for 1963.)

UNPUBLISHED TALKS AND PAPERS

GEDNEY, DONALD R.
The Experiment Station looks at allowable cut. Society of American Foresters meeting, Gilchrist, Oreg. April.

(Discussed the concept used by the Experiment Station in developing allowable cut estimates for eastern Oregon.)

MARKETING

PUBLICATIONS

ADAMS, THOMAS C.
Production, prices, employment, and trade in Pacific Northwest forest industries, 4th quarter 1963. Pac. NW. Forest & Range Expt. Sta., 19 pp., illus.

(Provides current information on lumber and plywood production and prices, employment in the forest industries, international trade in logs and lumber, volume and average prices of stumpage sold by public agencies, and other related items.)

Production, prices, employment, and trade in Pacific Northwest forest industries, 1st quarter 1964. Pac. NW. Forest & Range Expt. Sta., 16 pp., illus.

(Provides current information on lumber and plywood production and prices, employment in the forest industries, international trade in logs and lumber volume and average prices of stumpage sold by public agencies, and other related items.)

Production, prices, employment, and trade in Pacific Northwest forest industries, 2nd quarter 1964. Pac. NW. Forest & Range Expt. Sta., 17 pp., illus.

(Provides current information on lumber and plywood production and prices, employment in the forest industries, international trade in logs and lumber, volume and average prices of stumpage sold by public agencies, and other related items.)

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and HAMILTON, THOMAS E.
Production, prices, employment, and trade in Pacific Northwest forest industries, 3rd quarter 1964. Pac. NW. Forest & Range Expt. Sta., 20 pp., illus.

(Provides current information on lumber and plywood production and prices, employment in the forest industries, international trade in logs and lumber volume and average prices of stumpage sold by public agencies, and other related items.)

FEDKIW, JOHN.
Forest industry capacity, production, and available log supplies in the Douglas-fir subregion. U.S. Forest Serv. Res. Paper PNW-11, 63 pp., illus.

(Relations of capacity, production, and available log supplies are described in the lumber, plywood, and pulp industries of western Oregon and western Washington. Prospectively available log supplies are indicated by allowable-cut plans of public forestry agencies and by projections of available log supplies from private timberlands.)

MANETSCH, THOMAS J.*
Computer simulation of the economics of the United States softwood plywood industry.

*Federal, State, or private cooperator.

Oreg. Agr. Expt. Sta. Spec. Rpt. 180, 18 pp., illus. (Available at Oregon State University.)

(Describes a comprehensive model of the softwood plywood industry and by computer simulation tests effect of important variables, effective prices, production rates, and profits in the industry.)

MEAD, WALTER J.*

Mergers and economic concentration in the Douglas-fir lumber industry. U.S. Forest Serv. Res. Paper PNW-9, 81 pp., illus.

(Examines the trend over the last several decades. Merger activity has increased, but the degree of concentration is low relative to concentration ratios elsewhere in the American economy.)

UNPUBLISHED TALKS AND PAPERS

ADAMS, THOMAS C.

What is the impact of log exports on forest land management? Society of American Foresters meeting, Portland, Oreg. September.

Pacific Northwest log exports. Society of American Foresters meeting, Redmond, Oreg. November.

(These two talks discuss the current log export situation in the Pacific Northwest and the effect of log exports on forest management.)

COWLIN, R.W.

Potential income and employment from timber resources of the Flathead Indian Reservation. Administrative report prepared for the Bureau of Indian Affairs, 43 pp., illus. August.

(Analyzes the potential of the timber resource to provide increased employment for tribal members.)

GEDNEY, DONALD R.

Forest products industry study. Third meeting of Pacific Northwest Economic Base Study Advisory Committee, Portland, Oreg. February.

(Presented the highlights of a forthcoming report to Bonneville Power Administration on the present and potential of the forest resources and forest industries in the Columbia Basin.)

NEWPORT, CARL A.

Timber trends in western Oregon and western Washington. Timbermen's meeting, Springfield, Oreg. May.

(Summary and discussion of U.S. Forest Service Research Paper PNW-5.)

U.S. FOREST SERVICE.

Forest resources and forest industries for northeast Washington. Administrative report prepared for Area Redevelopment Administration, 53 pp., illus. January.

(Analyzes the potential for expansion of the timber industry insofar as raw material and industrial technology are concerned.)

*Federal, State, or private cooperator.

MENSURATION AND SURVEY

PUBLICATIONS

BERNSTEIN, DAVID A.

A test of stand age estimation from aerial photos in even-age Douglas-fir. Photogrammetric Engin. 30: 242-245, illus.

(On the basis of a test of a formula for determining stand age, using aerial photo measured tree heights and crown closure, it was concluded that such use of aerial photos was impractical.)

BRIEGLEB, PHILIP A.

Timber trends in the Pacific Northwest. Amer. Forest Prod. Indus. Inc. Proc. 1964: 66-71. (Reprints not available.)

DAHMS, WALTER G.

Gross and net yield tables for lodgepole pine. U.S. Forest Serv. Res. Paper PNW-8, 14 pp., illus.

(Integrates a gross increment equation, derived from measurements in numerous lodgepole pine stands in central Oregon with age to produce a yield equation.)

FLORA, DONALD, and FEDKIW, JOHN.

Volume growth percent tables for Douglas-fir trees. Pac. NW. Forest & Range Expt. Sta., 145 pp., illus.

(Annual volume growth percents are tabulated for individual young Douglas-fir trees of different diameters, ages, and sites, by rate of growth in rings per inch. Use of volume growth percents to estimate value growth percents, and their application in marking for commercial thinning are discussed.)

HAZARD, JOHN W., and
METCALF, MELVIN E.

Forest statistics for southwest Oregon. U.S. Forest Serv. Resource Bul. PNW-8, 32 pp.

(Summarizes the results of the latest reinventory of five counties in southwest Oregon: Coos, Curry, Douglas, Jackson, and Josephine. Field data collected 1955-62 for the five National Forests involved (1962 for all lands outside the National Forests) and adjusted to January 1, 1963.)

METCALF, MELVIN E., and
HAZARD, JOHN W.

Forest statistics for northwest Oregon. U.S. Forest Serv. Resource Bul. PNW-7, 38 pp.

(Summarizes results of the latest reinventory of 10 counties in northwest Oregon: Clackamas, Clatsop, Columbia, Hood River, Marion, Polk, Tillamook, Washington, and Yamhill. Field data collected 1961 (Siuslaw National Forest, 1956) and adjusted to January 1, 1963.)

MISCELLANEOUS

PUBLICATIONS

ANONYMOUS.

Forest Service -- Research. In Federal Careers in the Northwest. U.S. Civ. Serv. Comn., pp. 12-13, illus. (Reprints not available.)

PACIFIC NORTHWEST FOREST & RANGE EXPERIMENT STATION.

1963 annual report, the fifty and fiftieth year(s). 74 pp., illus.

(A summary of the Station's accomplishments for the calendar year 1963 and plans for 1964.)

Silviculture Laboratory, Bend, Oregon. 16 pp. (unnumbered), illus.

(A brochure illustrating the design and purpose of the Silviculture Laboratory in Bend, Oreg.)

UNPUBLISHED TALKS AND PAPERS

BRIEGLEB, PHILIP A.

The forester in a science-oriented society. University of California School of Forestry 50th anniversary alumni meeting, Berkeley. December.

Remarks at University of Washington Hugo Winkenwerder Forest Sciences Laboratory Dedication, Seattle, Wash. May.

RANGE

PUBLICATIONS

COSTELLO, DAVID F.

Current trends in range-management research. Herb. Abs. 34: 75-78.

(Discusses present trends in range research, including centralization of effort, increase in basic studies, changes in research organization, new fields for investigation, and the increase in interdisciplinary research. Considers private research an unpredictable factor.)

Range dynamics control -- an ecological urgency. In Grazing in Terrestrial and Marine Environments, ed. by D.J. Crisp. Fourth Symposium Brit. Ecol. Soc. pp. 91-107.

(A discussion of application of ecological principles to grazing management in the United States, the history of the range in western America, and a statement of management needs for the future.)

DRISCOLL, RICHARD S.

A relict area in the central Oregon juniper zone. Ecology 45: 345-353, illus.

(Describes the vegetational and soil characteristics of two plant associations on a near virgin area in the central Oregon juniper zone. Heavy grazing on nearby areas has greatly reduced the perennial plants and increased the abundance of cheatgrass brome.)

RECREATION

PUBLICATIONS

BURCH, WILLIAM R., JR.

A new look at an old friend--observation as a technique for recreation research. Pac. NW. Forest & Range Expt. Sta., 19 pp.

(This paper indicates some problem areas where systematic participant-observer techniques may be usefully applied in forest recreation research. These general issues are illustrated with specific examples from a preliminary field test of two observational schedules.)

Two concepts for guiding recreation management decisions. Jour. Forestry 62: 707-712, illus.

(Suggests some concepts and patterns of thinking which may aid the resource manager in accomplishing his recreation management goals of public service and resource protection.)

Who goes into the Three Sisters Wilderness Area, and why do they go? Northwest Conifer 10(5): 10-11. (Reprints not available.)

(A summary of a study exploring the social meaning of nature, based on questionnaire returns from 89.7 percent of a sample of 997 campers.)

WENGER, WILEY D., JR.

A test of unmanned registration stations on wilderness trails: factors influencing effectiveness. U.S. Forest Serv. Res. Paper PNW-16, 48 pp., illus.

(Unmanned registration stations can be effective in obtaining wilderness recreational-use information. In an intensive 2-year test of stations, the average registration rate was between 70 and 85 percent. The report evaluates and discusses effective design, location, and prescribed system for use of stations on wilderness trails. Stations may yield more meaningful data at less cost than possible with other unmanned devices.)

_____ and GREGERSEN, H.M.

The effect of nonresponse on representativeness of wilderness-trail register information. U.S. Forest Serv. Res. Paper PNW-17, 20 pp., illus.

(Knowing how nonresponse affects the representativeness of wilderness-trail register data, we can increase its usefulness for management and further research. Interview survey data showed that horse-users, fishermen, elk hunters, single-person parties, and frequent or longtime users tended to be underrepresented by registration data from the two Oregon areas studied. Research aimed directly at the social characteristics associated with differing responses could aid managers to better accommodate specific needs of specific user classes.)

UNPUBLISHED TALKS AND PAPERS

BURCH, WILLIAM R., JR.

Recreation research--its role in improving forest recreation management. Oregon State University School of Forestry, Corvallis, Oreg. March.

Wilderness recreation research in the Forest Service. Part II. Fifth Biennial Conference on Northwest Wilderness, Portland, Oreg. April.

(Understanding of wilderness recreation requires that our analysis of values recognizes that quality cannot be known by its quantity. As newly discovered facts about wilderness recreationists are related to one another, research uncovers a complex world in contrast to the simplicities of the conventional wisdom. By considering differences in perceptions and perspectives of different groups, we might better provide an appropriate fan of leisure opportunities to permit more persons to fit their own life cycle to the cycles of society and nature.)

HUGHES, JAY M.

Bureaucracy, communication, and wilderness. Fifth Biennial Conference on Northwest Wilderness, Portland, Oreg. April.

(This paper discusses some of the political science aspects of wilderness land allocation decision making against the

backdrop of the Pacific Northwest experience.)

Wilderness land allocation in a multiple use forest management framework in the Pacific Northwest. Ph. D. thesis, Michigan State University, East Lansing, Mich. 597 pp., illus. November.

(This thesis reports on a major study of wilderness land allocation, especially in the Pacific Northwest, and develops relevant economics methodologies and other concepts useful for a broad understanding of the topic.)

WENGER, WILEY D., JR.

Wilderness recreation research in the Forest Service. Part I. Fifth Biennial Conference on Northwest Wilderness, Portland, Oreg. April.

(Answers to questions about wilderness recreation require the collecting of facts and the relating of these facts to one another as theories. Successful wilderness recreation research requires freedom to be skeptical of existing theories about wilderness, whether they are stated or implied, whether revered by user groups or agency officials, and to use appropriate techniques and language systems to test these theories. Through excellent outdoor club cooperation some progress has been made in description of wilderness recreational use.)

SILVICULTURE

PUBLICATIONS

BARRETT, JAMES W.

A cart for a neutron probe and scaler. Jour. Forestry 62: 501-502, illus.

(Describes construction of a two-wheeled cart for transport of a neutron probe and scaler in forested areas. Requires only one man for use.)

BRIEGLEB, PHILIP A.

Is economic analysis alone the appropriate yardstick for reforestation? In Western Reforestation 1963; economics of reforestation. West. Forestry & Conserv. Assoc. West. Reforestation Coordinating Com. Proc. 1963: 1-2 (Reprints not available.)

DIMOCK, EDWARD J. II.

Simultaneous variations in seasonal height and radial growth of young Douglas-fir. Jour. Forestry 62: 252-255, illus.

(Progressive changes in bole circumference and total height were simultaneously measured in 10 Douglas-fir trees during the 1957 and 1958 growing seasons. Apparent initiation of height growth after radial growth is a noteworthy departure from observations by others.)

Supplemental treatments to aid planted Douglas-fir in dense bracken fern. U.S. Forest Serv. Res. Note PNW-11, 10 pp.

(Reports that neither fertilizing tree seedlings nor reducing bracken competition by cutting, spraying, or suppressing with heavy paper improved survival or growth of planted Douglas-fir. Animal damage, moreover, nearly doubled on seedlings exposed by bracken reduction.)

FRANKLIN, JERRY F.

Color of immature cones of several Pacific Northwest conifers. Forest Sci. 10: 103-104.

(In the Cascade and Coast Ranges of Oregon and Washington, *Abies amabilis*, *A. lasiocarpa*, *A. magnifica* var. *shastensis*,

A. procera, Picea engelmannii, Pinus monticola, Pseudotsuga menziesii, and *Tsuga mertensiana* can produce immature cones either red (or purple) or green in color. Abundance and distribution of the color varies in each species. Variation in cone coloration on individual trees is related to exposure of the cones to sunlight.)

Douglas' squirrels cut Pacific silver fir cones in the Washington Cascades. U.S. Forest Serv. Res. Note PNW-15, 3 pp., illus.

(The Douglas' squirrel *(Tamiasciurus douglasii douglasii)* cuts the cones from Pacific silver fir *(Abies amabilis)* trees, directly affecting both present and future seed crops of this species.)

Some notes on the distribution and ecology of noble fir. Northwest Sci. 38: 1-13, illus.

(Places its northern limit in the Cascades apparently near Stevens Pass, but its southern limit cannot be pinpointed until taxonomic relationships in the noble-Shasta-California red fir complex are clarified. Pure stands of noble fir occur regularly, and it seems more tolerant than previously supposed. Yields can be high.)

GENTLE, STANLEY WALLACE.*

The effect of local weather conditions on the assimilation of carbon dioxide by Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) in western Washington. Diss. Abs. 25(2): 730-731. (Reprints not available.)

(CO_2 assimilation was strongly influenced by the apparent capacity of the ambient air mass to maintain needle hydrature. Fog, high humidities, and low temperatures promoted assimilation. Unsaturated air even at low temperatures increased respiratory activity, as did very dry soil. Poor light had relatively little influence in diminishing CO_2 assimilation.)

HELMS, JOHN A.*

Apparent photosynthesis of Douglas-fir in relation to silvicultural treatment. Forest Sci. 10: 432-442, illus. (Reprints not available.)

(Apparent photosynthesis of a 40-year Douglas-fir in western Washington was measured with an infrared gas analyzer for 1½ years prior to treatment and 1 year following. Thinning, pruning, and decapitation increased photosynthetic efficiency of foliage, whereas fertilization had no appreciable effect. Differences in assimilation rates between trees were apparently not due to genetic variability.)

HELMS, JOHN ANDREW.*

Seasonal patterns of apparent photosynthesis in *Pseudotsuga menziesii* (Mirb.) Franco in relation to environment and silvicultural treatment. Diss. Abs. 25(5): 2689-90. (Reprints not available.)

(Characteristic seasonal net assimilation patterns of dominant, codominant, and suppressed trees, and effects of thinning, pruning, fertilizing, irrigation, and decapitation on these patterns, were assessed on mature trees in their natural environment by use of an infrared gas analyzer. The influence of light intensity, air temperature, and relative humidity was investigated, as was the relationship between photosynthetic production and production of dry matter.)

HERMAN, FRANCIS R.

Epicormic branching of Sitka spruce. U.S. Forest Serv. Res. Paper PNW-18, 9 pp., illus.

*Federal, State, or private cooperator.

(Presents effects of thinning and road right-of-way cutting on origin and development of epicormic branches on Sitka spruce. Light thinning did not cause significant increases in growth of epicormic sprouts. Stems bordering right-of-way cuttings had an abundance of vigorous sprouts.

Suggests that moderate to heavy thinning will stimulate epicormic branching, but such sprouting should have little influence upon quality of pulpwood and structural lumber.)

McMAHON, ROBERT O.

Private nonindustrial ownership of forest land. Yale Univ. Bul. 68, 122 pp., illus. (Available from Yale University.)

(Identifies determinants of forest management intensity on nonindustrial forest holdings in U.S. from the viewpoint of economic theory and relates to such facts as are now available in published empirical studies. This deductive analysis concludes that further empirical study is not necessary as a basis for revising current policies and programs for encouraging more intensive management by nonindustrial owners.)

NEWPORT, CARL A.

To what extent do nontimber values help justify reforestation? In Western Reforestation 1963; economics of reforestation. West. Forestry & Conserv. Assoc. West. Reforestation Coordinating Com. Proc. 1963: 9-11, illus. (Reprints not available.)

(Presents some evidence that nontimber values have been used to a great extent to justify reforestation and cites the need for more organized analysis using both social and economic justifications.)

PAYNE, BRIAN R.

Trends in reforestation and its cost in the Pacific Northwest. Pac. NW. Forest & Range Expt. Sta., 11 pp., illus.

(Examines the current annual reforestation job and changes in total reforestation expenditures and costs per acre since the late 1940's; suggests reforestation effort be concentrated on the more favorable sites.)

REUKEMA, DONALD L.

Crown expansion and stem radial growth of Douglas-fir as influenced by release. Forest Sci. 10: 192-199, illus.

(Release of 40-year-old codominant trees tended to reduce crown expansion during the first few years following thinning, but stem radial growth was increased, especially on the lower stem. Apparently, crown build-up was not a major factor in stem growth response.)

Litter fall in a young Douglas-fir stand as influenced by thinning. U.S. Forest Serv. Res. Note PNW-14, 8 pp., illus.

(A 13-year record from a young Douglas-fir stand illustrates how amount and timing of litter fall are affected by thinning treatment and climatic variations.)

Some effects of freeze injury on development of Douglas-fir. Northwest Sci. 38: 14-17, illus.

(Documents that radial growth in 1956, following the November 1955 cold wave, averaged 51 percent of the 1954-55 rate on 50-year-old codominant trees. Growth then increased regularly through 1959, when it reached 87 percent of the 1954-55 rate. Fast growing trees were most affected but recovered faster after the freeze. Height and branch growth were also curtailed.)

ROTHACHER, JACK S., and
FRANKLIN, JERRY F.

Fertilizer pellets improve growth of planted Douglas-fir on an unfavorable site.

Tree Planters' Notes 67, pp. 9-11, illus.

(Adding fertilizer pellets to planting holes significantly improved growth of Douglas-fir seedlings in all five growing seasons after planting on an old landing. But survival was the same with or without fertilizer, 87 percent.)

SILEN, ROY R.

A laboratory seed separator. Forest Sci. 10: 222-223, illus.

(A 16-inch-high, tubular plastic, continuous-production device for blowing the hollow seeds from small lots of coniferous seed is described.)

Pollen contamination and isolation. Indus. Forestry Assoc. Tree Impr. Newslet. 1: 15-16. (Reprints not available.)

(Some pollen contamination of seed orchards seems inevitable in the Douglas-fir belt because of high background pollen levels. Trees isolated several miles produce one-fourth or more of full seed set. Results follow mathematical predictions.)

STEIN, WILLIAM I.

More natural regeneration by controlling seed-eating rodents. U.S. Forest Serv. Res. Note PNW-12, 10 pp., illus.

(Total germination of ponderosa pine was increased fourfold by poisoning of rodents. Douglas-fir and sugar pine were not similarly benefited.)

TARRANT, ROBERT F.

Forest soils research in Oregon and Washington (a bibliography with abstracts through 1963.) U.S. Forest Serv. Res. Paper PNW-15, 29 pp.

(This paper references and briefly summarizes all published forest soils research done in Oregon and Washington from 1914 through 1963.) Major findings, or theme, of each reference are briefed, and a subject matter index is provided.)

Top and root moisture content of stored Douglas-fir planting stock. U.S. Forest Serv. Res. Paper PNW-13, 8 pp., illus.

(When Douglas-fir planting stock was exposed to drying conditions, roots lost increasingly more moisture than tops. Differential drying of tops and roots may explain some puzzling early-season mortality of planted seedlings.)

TRAPPE, JAMES M.

Populus trichocarpa seeds endure adversities. Tree Planters' Notes 65: 31.

(Despite adverse conditions of collection, storage, and treatment, these seeds produced a good crop of seedlings.)

WORTHINGTON, NORMAN P., and FEDKIW, JOHN.

Economic considerations in management of Douglas-fir growing stock--a case study. U.S. Forest Serv. Res. Paper PNW-12, 17 pp., illus.

(Economic analysis indicates management with thinnings increased total net income after taxes by 3.6 percent.)

_____ and HEEBNER, CHARLES F.

Light thinning of Douglas-fir does not stimulate regeneration. U.S. Forest Serv. Res. Note PNW-16, 5 pp., illus.

(Light, frequent thinnings at McCleary Experimental Forest stimulated Douglas-fir germination, but not survival. Inadequate light intensity and increased vegetative cover probably are the chief reasons for poor survival.)

UNPUBLISHED TALKS AND PAPERS

BRIEGLEB, PHILIP A.

Incentives for investment in forestry in the United States and Canada. Society of American Foresters meeting, Vancouver, British Columbia. May.

GRATKOWSKI, H. J.

Varnishleaf ceanothus on cutover forest lands in the Pacific Northwest. Weed Society of America meeting, Chicago, Ill. February.

(Described the varnishleaf brush problem on forest lands and reported results of autecological research on effects of slash disposal and high soil temperatures on germination of ceanothus seeds.)

Chemical methods of site preparation and release: U.S. Forest Service and Bureau of Land Management practices. Artificial Forest Regeneration short course, Oregon State University, Corvallis, Oreg. May.

(Described Forest Service practices using herbicides for site preparation and for releasing conifers from brush competition. Presented results of latest Forest Service research in this field.)

SILEN, ROY R.

Regeneration aspects of the 50-year-old Douglas-fir heredity study. Western Forestry & Conservation Association Western Reforestation Coordinating Committee meeting, Spokane, Wash. December.

(Survival of trees at all five locations of the Douglas-fir heredity study was uniformly high the first quarter century. Now, at 50 years, it varies by location from 27 to 74 percent. Races and individual families, superior at one location, are usually average or inferior elsewhere. Good growth is related with good survival. Seedlings poorly predict performance of 50-year-old trees.)

Theory of the practices. Artificial Forest Regeneration short course, Oregon State University, Corvallis, Oreg. May.

(Cone crops in Douglas-fir can be affected over a 16-month-long developmental period. During the last 12 months, the effects are visible in the form of insect or frost damage, poor pollination, or abortions. Experiments with fertilizer, floral debudding, and shading indicate that the crop can be altered up to 16 months ahead of seedfall.)

STEIN, WILLIAM I.

Seedspotting--revival of an old technique. Western Forestry & Conservation Association Western Reforestation Coordinating Committee meeting, Spokane, Wash. November.

(Sugar pine, ponderosa pine, and other species can be successfully established by seedspotting. With further improvements in tools and techniques, use of seedspotting will increase beyond the several thousand acres now being reforested annually by this method.)

Seedspotting techniques in the mixed type. Artificial Forest Regeneration short course, Oregon State University, Corvallis, Oreg. May.

(A review of investigative steps leading to current seedspotting practices now used operationally in regenerating sugar and ponderosa pine in southwestern Oregon. Recommended techniques and advantages of seedspotting are also discussed.)

No title. Society of American Foresters radio program, Station KWJJ, Portland, Oreg. December.

(Describes how professional foresters in the Seeding, Planting, and Nursery Practices Project of the Pacific Northwest Forest and Range Experiment Station are striving to improve vigor of nursery stock.)

TARRANT, ROBERT F.

Forest soil improvement through growing red alder (*Alnus rubra* Bong.) in Pacific Northwestern United States. VIII Congress of the International Society of Soil Science, Bucharest, Rumania. August.

(Compared with other species of *Alnus* studied throughout the Northern Hemisphere, red alder *(Alnus rubra)* is at least equally effective in improving soil fertility and growth of associated trees. Silvicultural application of soil-improving and tree-growth-promoting qualities of red alder is considered to be feasible and desirable.)

A hypothesis on some deaths of newly planted Douglas-fir seedlings. Artificial Forest Regeneration short course, Oregon State University, Corvallis, Oreg. May.

(Douglas-fir planting stock gained moisture over a period of 8 weeks in cold storage. Roots gained at a faster rate than tops. When seedlings were subsequently dried slowly, roots lost increasingly more moisture than tops. Difference between top and root moisture was inversely related to seedling dry weight.

Differential drying of tops and roots may explain some puzzling early-season mortality of planted seedlings.)

Forest soils. Society of American Foresters radio program, Station KWJJ, Portland, Oreg. August.

(In the present era of intensively managed forests, the role of the forest soil is clearly as important as that of agricultural soils long studied and managed for maximum crop production. We need a great deal of new information on soil, and we are well into the research that will give us this information. Our first goal in forest land management must always be to conserve the productive soils we have inherited and, wherever possible, to improve their conditions.)

TRAPPE, JAMES M., and
KRUEGER, KENNETH W.

Seedling biographies--keys to rational nursery practice. Western Forest Nurserymen's Association meeting, Boise, Idaho, August; **also,** Western Forestry & Conservation Association Western Reforestation Coordinating Committee meeting, Spokane, Wash. November.

(Nursery practices should be based on thorough knowledge of seedling growth patterns and abilities. Use of systematically compiled seedling biographical data in nursery decision making is illustrated from the authors' studies of Douglas-fir.)

WATERSHED

PUBLICATIONS

BETHLAHMY, NEDAVIA.

Improved procedure for calculating stream discharge. U.S. Forest Serv. Res. Paper PNW-10, 6 pp., illus.

(An integration method for computing discharge more accurately with fewer hydrograph readings.)

DUNFORD, E. G.

Areas of deficiency and research needs in water resource planning. **In** Water Re-

sources Management for the Needs of an Expanding Society. Water Resources Mangt. Proc., Univ. Wash. pp. 110-112. (Reprints not available.)

(Reviews obstacles confronting managers of forest and range watersheds and discusses the role of research in developing better management methods. Lists categories of basic research needed and describes watershed investigations being conducted by educational institutions and Federal agencies in the Pacific Northwest.)

ROTHACHER, JACK

Watershed lore being developed. Oreg. Grange Bul. 63(15): 10, illus. (Reprints not available.)

(On the H.J. Andrews Experimental Forest in western Oregon, researchers are studying intensively the characteristics of three small watersheds heavily forested with Douglas-fir timber--important to the farmer since a large portion of the water he uses originates on forested watersheds.)

WOOLDRIDGE, DAVID D.

Effects of parent material and vegetation on properties related to soil erosion in central Washington. Soil Sci. Soc. Amer. Proc. 28: 430-432.

(Soil properties are directly influenced by parent material type and horizon development and indirectly influenced by forest and grass vegetation. Soil erosion hazard is apparently related to soil organic matter, pH, total soil porosity, and bulk density.)

YOUNGBERG, C.T.,* and DYRNESS, C.T.

Some physical and chemical properties of pumice soils in Oregon. Soil Sci. 97:391-399, illus. (Reprints not available.)

(A discussion of distribution and properties with recommendations on mechanical analysis procedures.)

*Federal, State, or private cooperator.

UNPUBLISHED TALKS AND PAPERS

FOWLER, WILLIAM B.

The energy budget and its use in estimating evapotranspiration. 64th annual meeting of Society of American Foresters, Denver, Colo. September.

(Through a brief discussion of the energy budget, the requirements for its use as a framework for evapotranspiration (ET) estimation procedures are indicated.)

Instrumentation for radiation sampling in the forest environment. Joint seminar of U.S. Department of Agriculture and Weather Bureau, Washington, D.C. October.

(Sampling of radiation in the forest environment with any degree of certainty of result depends on awareness of the natural variation which can be expected and use of adequate sampling method and instrumentation for evaluation.)

HARRIS, ROBERT W.

No title. On soil and water resource research. Society of American Foresters radio program, Station KWJJ, Portland, Oreg. November.

WOOLDRIDGE, DAVID D.

Tracing soil particle movement with Fe^{59}. American Society of Agronomy and Soil Science Society of America joint annual meeting, Kansas City, Mo. November.

(Rates and patterns of actual soil particle movement were established by measuring changes with time in radiation intensity on an eroding sandstone soil.)

WILDLIFE

UNPUBLISHED TALKS AND PAPERS

DIMOCK, EDWARD J. II.

Animal damage control research, Pacific Northwest Station. Wildlife Management Conference, Washington National Forests, sponsored by U.S. Forest Service R-6 Division of Range and Wildlife Management, Seattle, Wash. December.

(In general, discussed project's early development, broad objectives, and cooperative relationships with work of other agencies; in particular, described research in chemical and silvicultural control methods.)

RADWAN, M. A.

Contact repellents for protecting forest seedlings from wild mammals. Program of Training for Animal Control, sponsored by U.S. Forest Service R-6 Division of Range and Wildlife Management, Vancouver, Wash. August.

(A report on the status of contact repellents in animal damage control with emphasis on TMTD and ZAC.)

SMITH, JUSTIN G.

The meaning of wildlife habitat research. Eastern Oregon College, La Grande, Oreg. January.

(A description of wildlife habitat research, including its objectives, organization in the Forest Service and Pacific Northwest Forest and Range Experiment Station, and illustrated examples.)

A wildlife habitat research program for the Northwest. Izaak Walton League, La Grande, Oreg. November.

(A thumbnail sketch of the Pacific Northwest Forest and Range Experiment Station program in wildlife habitat research with illustrated examples.)